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(54) **DEVICE FOR ADJUSTING THE TENSION OF THE PILE WARP YARNS IN A TERRYCLOTH WEAVING LOOM**

(57) Device for adjusting the tension of the pile warp yarns, in a mobile breast-beam terrycloth weaving loom, comprising a pile warp roll assembly (G) with a warp tensioner (13) roll provided with a negative compensation movement. The same kinematic system of the alternate movement of the breast-beam (F), also drives the leverage of a corresponding positive compensation movement of said warp tensioner roll (13).

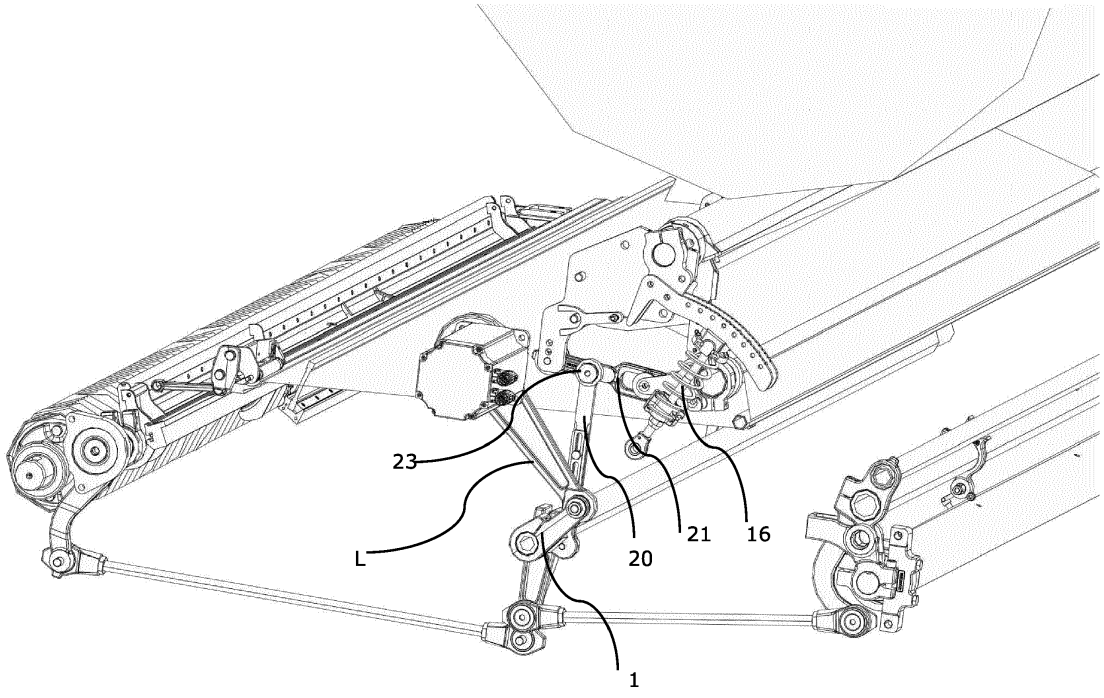

FIG. 2

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Description

FIELD OF THE INVENTION

[0001] The present invention belongs to the field of weaving looms for the production of terrycloth fabrics, also referred to, for brevity, as terrycloth looms. In particular, the invention relates to a device for adjusting the tension of the pile warp yarns in a weaving loom for the production of terrycloth fabrics.

BACKGROUND ART

[0002] As it is well known to those skilled in the art, the production of terrycloth fabric takes place by means of two series of warp yarns: usual warp yarns forming the base fabric of the terrycloth and, just for this reason, maintained constantly tight, and pile warp yarns, intended to precisely form a series of loops of thread - indicated in the field as "piles" - at least on one side and preferably on both sides of the fabric and having variable height with respect to the base fabric. In the looms for the production of terrycloth it is therefore provided an additional warp's beam - normally placed in an elevated position above the loom - dedicated to the provision of the warp yarns for forming the pile (pile beam).

[0003] The unwrapping of the pile warp yarns is generally controlled by an adjustment system which adjust the unwrapping speed of the pile beam and the wrapping speed of the fabric, which adjustment system allows to adjust the tension of the pile warp yarns in a totally independent way from the tension of the base warp and in such a way to allow the regular forming of constant height piles. However, to avoid undesired warp tension rises during the opening step of the warp yarns for the shed-forming and the reed beating-up for forming the pile, the warp yarns going out from the pile beam pass through a pile warp roll assembly (in the field referred to as top pile warp roll assembly), along a path having a variable length according to the position taken by one of the rolls (referred to as "warp tensioner" or "warp tensioner roll") with respect to the fixed position of the other rolls of the assembly, in order to compensate the increase of the path length imposed to the pile warp yarns during the steps of shed opening and of reed beating-up for forming the pile. The movement of the warp tensioner roll is countered by suitable elastic means, which are adjusted in order to allow such movement when the tension of the pile warp yarns, due to the increase of the path length, exceeds a predetermined value. This length compensation takes place then in an automatic and not controlled way and is therefore referred to as a "negative" compensation.

[0004] Terrycloth is obtained thanks to the fact that the reed, in addition to the usual first beating-up position against the fabric being woven, is also provided with a second backward beating-up position, set at a different distance with respect to the first one, which distance corresponds to twice the desired height of the pile. In this second backward operating position of the reed, two successive wefts, in the most frequent case, are beaten-up and tied to the warp yarns and then, at the subsequent weft insertion, the reed resumes the normal beating-up position, thus dragging in this position also the two wefts already beaten-up in the backward position. These two weft then slide on the permanently tensioned base warp yarns and drag forward the pile warp yarns - thanks to the fact that these latter at this step are kept at a tension so low that do not slide with respect to the two inserted wefts - so forming the piles.

[0005] Depending on the fabric structure set in the weaving machine, it is then possible to obtain terrycloth with piles on only one of the sides of the fabric or on both sides thereof, and this both evenly and as a function of a desired more or less complex pattern, obtained by means of traditional weaving machines operating the heald frames of a loom or, instead, of Jacquard machines that directly operate the individual healds.

[0006] As far as regards the terrycloth manufacturing method, looms are divided into two categories, depending on the type of mechanical arrangement with which the aforesaid backward beating-up position of the reed is obtained. In a first loom category, it is the same sley, i.e. the reed movement member, which is provided with a second backward beating-up position, obtained thanks to a modification of the relative control system. In a second loom category - wherein the adjustment device of the present invention is comprised - the reed maintains its usual single beating-up position and some of the elements that take part to the weaving process - i.e. both the base warp yarns and the pile warp yarns, the breast-beam, the warp guide roll of the base warp yarns and the fabric being woven - are shifted back and forth with a reciprocating and synchronized movement, in order to move away/approach the forming line of the fabric from/to the different beating-up position of the reed. Even in this case it is therefore determined a "normal" beating-up position and a "retracted" beating-up position of the reed, if a reference system fixed to the fabric being woven is considered, despite the fact that the reed has a single and constant beating-up position with respect to a reference system fixed to the loom.

[0007] One of the problems concerning the second solution above is the not satisfactory compensation of the increase of tension of the pile warp yarns caused by the forward displacement of the fabric being woven. While, in fact, in the base warp yarns this compensation is not necessary - since the translation mechanism of the breast-beam moves, to the same extent, both the base warp guide roll deflecting the base warp yarns coming from the warp beam, and the breast-beam deflecting the newly formed fabric on the fabric beam - in the pile warp yarns a compensation is indeed essential considering that the positive translation of said pile warp yarns is performed at the side of the fabric being woven, but not at the side of the pile beam.

[0008] In the solutions known up to now, the compensation of this dissymmetry of the pile warp yarns positive displacement is achieved thanks to the same negative compensation mechanism that governs the maintenance of a correct tension of the pile warp yarns during the shed opening and the reed beating-up for forming the pile. Simply, the adjusting of the elastic contrast member of said mechanism is performed so as to also consider this additional need for compensation. However the displacement of the pile warp yarns causes a variation of the tension of the elastic contrast member, with a relative modification of the dynamics of the negative system, just a moment before forming the pile, which step requires instead a controlled and constant tension of the yarn. Such variations are also not constant, when considering on one side that the extent of translation of the pile warp yarns can vary for requirements imposed by the design of the terrycloth, during the same weaving process and, on the other side, that the negative compensation is affected by the inertia of the system and thus its response varies with the speed of the loom. This is therefore a complex system with multiple variables for which therefore it is difficult to determine a setting which satisfies both of the above different compensation requirements.

[0009] EP-1669483 (Tsudakoma) discloses a loom for the production of terrycloth belonging to the second category described above, in which a warp tensioner roll of the top pile roll assembly is moved back and forth, in the direction of advancement of the fabric, by means of a lever mechanism controlled by an appropriate electric stepping motor, synchronously with the reciprocating motion of the base warps yarns and of the fabric being woven. This latter movement is obtained, in a per se known manner, by providing the guide rolls deviating the base warp yarns and the fabric being woven with a controlled oscillating movement, by means of a system of levers and rods driven by the main motor of the loom. Moving then forward all the elements described above, it is accomplished the goal of determining a second line of reed beating-up, set backward with respect to the ordinary one, without changing anything in the reed movement itself. Note that the directions: forward, backward, advanced and retracted, refers here and below to the normal direction of fabric feed in the loom.

[0010] In this patent it is disclosed, in particular, the use of the warp tensioner roll handling system, not only to maintain a constant tension of the pile warp yarns during the alternating movement of the fabric and of the base warp yarns, but also to determine an additional loosening of the pile warp yarns in case of stop of the loom - in order to avoid that the newly formed piles, still unstable, are undone as a result of a tension increase caused by the repairing operations - such additional loosening being different depending on the type of stop (breakage of the weft, breakage of the warp, stopping for work interruption, etc.).

[0011] In Tsudakoma patent the compensation of the increase of path length of the pile warps yarns due to the shed opening is not addressed; such compensation must therefore be obtained through the only known traditional way, namely by means of a warp tensioner roll that allows a "negative" compensation, as described above. It is clear that also in the Tsudakoma solution, and despite the fact that the compensation of the pile warp yarns translation is carried out here in a positive way, the effects of this compensation overlap in an uncontrolled manner those of the negative compensation of the shed opening movement, making more critical the proper setting of the system, for the same reasons discussed above.

[0012] A further drawback of the Tsudakoma patent is then the need for an additional electric motor to control the movement of the pile warp yarns, which raises the manufacturing costs of the loom and complicates its management.

SUMMARY OF THE INVENTION

[0013] The object of the present invention is therefore that of providing a loom for the production of terrycloth according to the "movable breast-beam" mode of the second category described above, in which the compensation of the alternating movement of the pile warp yarns, made necessary by the movement of the breast-beam, is achieved in a positive way, and above all independently from the negative compensation of the shed opening and of the reed beating-up for forming the pile, so that the two types of compensation do not influence each other.

[0014] Another object of the invention is then to obtain said positive compensation using the same drive which alternately moves the base warp yarns, without the need to introduce a specific drive motor to this purpose, thus greatly reducing the cost of the loom, the quality of the produced fabric remaining unaltered.

[0015] These objects are achieved by a device adjusting the tension of the pile warp yarns having the features defined in claim 1. Further preferred features of said device are defined in the dependent claims.

[0016] The adjusting device of the invention achieves this by acting on the position of the warp tensioner roll by means of two mutually independent mechanical systems: a first system imparts a "positive" movement of the warp tensioner roll to compensate the alternating translation movement of the fabric and of the breast-beam; a second system allows, in the traditional way, a "negative" displacement of the warp tensioner roll, independent from the "positive" displacement thereof, to compensate the increase of path length of the pile warp yarns caused by the shed opening and the reed beating-up for forming the pile.

[0017] By separating the drives and the effects of these two different compensations it is possible to control with greater accuracy the tension of the pile warp yarns, keeping it as constant as possible, despite the continuous and alternating variations of their path length caused by said textile movements and by the equally continuous possible variations in the cycle for forming the pile, both in

relation to its height and to its own presence/absence.

BRIEF DESCRIPTION OF DRAWINGS

[0018] Further features and advantages of the device for adjusting the tension of the pile warp yarns according to the present invention will anyhow become more evident from the following detailed description of a preferred embodiment of the same, given by mere way of a non-limiting example and illustrated in the accompanying drawings, wherein:

Fig. 1 is a schematic front view which illustrates the fundamental elements of a loom for the production of terrycloth, of the type with movable breast-beam;
Fig. 2 is an enlarged-scale and perspective view of some elements of the loom of Fig. 1, equipped with the device for adjusting the tension of the pile warp yarns of the present invention;
Fig. 3 is a further enlarged-scale view of only the top pile roll assembly of the pile warp yarns shown in Fig. 2;
Fig. 4A is a schematic cross-sectional view of the top pile roll assembly of the pile warp yarns of Fig. 3, in the closed shed working position;
Fig. 4B is an identical view to Fig. 4A, in the open shed working position, with negative compensation of the warp tensioner roll; and
Fig. 4C is an identical view to Fig. 4A, in the closed shed working position, and with the breast-beam in advanced position, with positive compensation of the warp tensioner roll.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Movement for terrycloth formation

[0019] The essential constitutive elements of a "movable breast-beam" terrycloth loom are shown in Fig. 1. As mentioned in the introductory part of the present description, this term indicates a particular category of looms for the production of terrycloth, in which the sley S alternately moves the reed P in a traditional way, namely with a single beating-up position, while the second beating-up position of the reed, necessary for forming the pile, is obtained by means of a forward motion, i.e. in the direction of the arrow K, of all the other elements that govern the formation of the fabric, i.e. the base warp yarns Wb, the pile warp yarns Wr, the fabric C and the breast-beam F.

[0020] Said translational forward movement of the various elements listed above, and the subsequent rearward movement when the reed beating-up position must go back to the ordinary one, are imparted by means of a kinematic system which includes a main connecting rod L, operated in alternating synchronized displacements by a motor M. The use of a dedicated motor M for driving this movement is preferred, compared to the more traditional solution of a movement derived by the main motor of the loom, considering that it is thus possible, with great ease, to control the execution of this movement both in amplitude and in frequency, also during the weaving of an article, in order to vary whenever desired the height and the ratio of the pile, based on the particular pattern of the terrycloth fabric. This latter, therefore, is not limited to the usual ratios of 3 wefts/1 pile or 4 wefts/1 pile, but includes all subsequent possible ratios up to N wefts/1 pile, while the amplitude of the translation movement may vary for each pile forming cycle, resulting in a theoretical height of the pile, variable from a zero value up to a maximum value corresponding to half the maximum possible translation amplitude of the warp yarns.

[0021] The alternating movement of the connecting rod L causes the movement of a lever 1, which, in turn, causes the corresponding rotation of a secondary lever 3, via a shaft 2 to which said levers are both fixed. On the free end of the lever 3 are finally pivoted a rear tie rod 4 and a front tie rod 5 which control, via respective levers 6 and 7, the alternating movement in the direction of the arrow K and in the opposite direction of the following devices of the loom:

- warp guide roll 8 (which provides the deviation of the base warp yarns Wb from the relative base warp beam Bb);
- breast-beam F; and
- fabric guide roll 9 (which provides the deviation of the newly formed fabric toward the fabric drawing roll 10 and the fabric beam Bc).

[0022] From the above, it comes out clear the problem already mentioned in the introductory part of the present description, i.e. that while the base warp yarns Wb undergo a longitudinal displacement having the same extent by the rolls 8 and 9, at their opposite ends, the same does not happens to the pile warp yarns Wr which are moved in the direction of the arrow K only in correspondence of the fabric guide roll 9, but not in correspondence of their opposite end, namely on the top pile roll assembly G of the pile warp yarns. The adjustment device of the present invention aims to solve this problem, offering a positive compensation of the pile warp yarns in this very position, so as to keep the tension of the pile warp yarns perfectly constant, like that of the base warp yarns, during the alternating translation movement of the breast-beam.

[0023] In addition to this primary object, the adjustment device of the invention proposes to obtain the positive compensation of the pile warp yarns in such a way as not to interfere with the usual negative compensation which is traditionally used to compensate the variations in the path length of the base warp yarns and of the pile warp yarns, due to the shed opening/closing and the reed beating-up for forming the pile. In order to better understand this aspect of the invention, it will be briefly described in the following the negative compensation mode

of the warp yarns, with particular reference to the pile warp yarns Wr, which compensation is carried out through an appropriate change of the geometric arrangement of the rolls in the top pile roll assembly G, during the shed opening and the reed beating-up for forming the pile.

Negative compensation of the pile warp yarns and of the base warp yarns

[0024] Said negative compensation of the top pile roll assembly G is necessary - as indeed in all the warp guide roll assemblies, and therefore in the guide roll assembly 8 of the base warps yarns Wb as well - during the shed opening of the weaving machine (dobby or Jacquard), when the pile warp yarns (coming from the upper pile beam Br) are stretched during the shed opening and during the reed beating-up for forming the pile and relaxed during the shed closing. Just to avoid these continuous tension variations and their consequent effects on the integrity and on the correct parallelism of the warp yarns, it has been provided the introduction of warp guide roll assemblies having a negative compensation system apt to automatically change the position of the roll assembly and consequently the length of the path of the warp yarns, depending from the level of tension of the yarns themselves.

[0025] To this purpose, and as it is shown clearly in Figs. 3 and 4, the top pile roll assembly G of the pile warp yarns comprises a first deviating roll 11 and a second deviating roll 12, both idly pivoted in fixed positions on the loom. A warp tensioner 13 completes the assembly and it is supported on the first deviating roll 11, through a series of levers 15 which connect in an integral manner the deviating roll 11 with the warp tensioner 13, passing around the deviating roll 12 at an appropriate distance from the same so as to avoid any possible interference during the oscillations of the warp tensioner 13. Consequently, the warp tensioner 13 and a yarn-carrying bar 14 of small diameter integral with the same, can rotate around the axis of the deviating roll 11, in response to the tension of the pile warp yarns Wr and to the contrast force of suitable adjustable elastic means 16 (Fig. 2), which connect the deviating roll 11 to the warp tensioner 13 at their opposite ends. The arrangement of the pile warp yarns Wr in the top pile roll assembly G is the one illustrated in Figs. 4, where it is possible to see that said yarns undergo a first forward deviation caused by the first deviating roll 11, a second backward deviation caused by the second deviating roll 12, and finally a last forward deviation caused by the warp tensioner 13 and relative yarn-carrying bar 14.

[0026] The adjustment of the elastic means 16 is set in function of the total load imparted by the pile warp yarns Wr, and therefore also of the total number of such yarns, so that in the conditions of shed closing the top pile roll assembly G is positioned as illustrated in fig. 4A. When the load of the wires increases, due to the effect of the shed opening or of the reed beating-up for forming the pile, the elastic means 16 are compressed and the warp tensioner 13 and relative integral yarn-carrying bar 14 can rotate around the axis of the deviating roll 11, until it reaches the final position shown in Fig. 4B. When looking to Fig. 4B it is clear how the new arrangement of the warp tensioner of the top pile roll assembly G brings about a clear reduction of the path length of the warp yarns Wr, therefore compensating the corresponding increase caused by the shed opening and by the reed beating-up for forming the pile.

[0027] A similar negative compensation device is of course provided in correspondence of the base warp guide roll 8.

Positive compensation of the pile warp yarns

[0028] The positive compensation device according to the present invention is moved by the same kinematic mechanism described above which determines the reciprocating motion of the breast-beam and that is driven by the motor M. The movement imparted to the connecting rod L by the motor M is transferred in fact - by means of the lever 1, the shaft 2 and a short crank also integral to the shaft 2 - to a connecting rod 20 which causes the oscillation of a lever 21, having a slot free end, with respect to the fixed fulcrum 22 of its opposite end (i.e. fulcrum 22 is hinged to the loom structure); the connection rod 20 and the lever 21 being joined together by a hinge 23. Both the position of the fulcrum 22 and that of the hinge 23 are adjustable on different discrete positions to allow the adjustment of the extent of the compensation.

[0029] The slot end of the lever 21 cooperates with a hinge-slide 24, apt to move inside the slot of the lever 21, and is pivoted to the end of a lever 25 integral with the warp tensioner 13, to cause the rotation of the same and of the yarn-carrying bar 14 which, as previously said, is fixed to the warp tensioner 13.

[0030] Thanks to this construction, during the alternating movement of the breast-beam F, lever 20 makes lever 21 oscillate around the fulcrum 22, dragging in this sliding movement also the hinge-slide 24. The linear movement transmitted to the end of the lever 25 causes the rotation of said lever and of the warp tensioner 13 around its own axis and therefore the forward displacement of the yarn-carrying bar 14. This movement, with an appropriate designing of the lever mechanism described above, causes a positive compensation on the pile warp yarns exactly corresponding to the displacement undergone by said yarns due to the movement, forth and back, of the breast-beam F and of the fabric guide roll 9, thus achieving the first object of the invention.

[0031] It will be appreciated then that the arrangement of the slot end of the lever 21 is such as to be substantially parallel to the arc of the circle that the hinge-slide 24 performs during the negative compensation movement of the warp tensioner 13, i.e. during the rotation of the warp tensioner 13 around the axis of the first deviation

roll 11. During this rotation, the hinge-slide 24 may therefore freely slide and without any frictions inside the slot end of the lever 21 and, vice versa, when the lever 21 is operated by the positive compensation device, it will not be determined any rotation of the warp tensioner 13 around the first deviation roll 11, but just a rotation of the warp tensioner 13 around its own axis. This arrangement therefore allows to clearly separate the positive and negative compensation of the top pile roll assembly G and the elastic means 16 are therefore not at all affected, or affected only in part, as will be said later, by the compensation of the variation of the path length of the pile warp yarns Wr caused by the alternating movement of the breast-beam F.

[0032] As a matter of fact, it is also possible, according to a variant of the invention, to change the inclination of the longitudinal axis of the longitudinal slot end of the lever 21 so that it shows a low inclination in relation to the arc of circle of the hinge-slide 24. In this way, it is possible to obtain a partial rotation of the yarn-carrying bar 14, and therefore a variable degree of positive compensation, even during the negative compensation movement of the warp tensioner 13 during the shed opening and the reed beating-up for forming the pile.

[0033] As stated above, the lever 21 is provided with a series of holes that allow to move its pivoting point on the reference rod 20. By moving this pivoting point, it is possible to obtain a variation of the positive compensation run of the yarn-carrying bar 14 of the pile yarns. The run of the reference rod 20 being equal, the more the pivoting point 23 is moved toward the fulcrum 22 the greater the rotation of the warp tensioner 13 and the displacement of the yarn-carrying bar 14 and, consequently, the positive compensation of the pile warp tensioner.

[0034] Through the adjustment of the pivoting point 23, substantially two different conditions may occur:

1. the run of the breast-beam is equal to the positive run of the yarn-carrying bar 14. This is the ideal design condition and in this case the negative compensation shall be used only during the shed opening movement and the reed beating-up for forming the pile;
2. the run of the breast-beam is greater than the positive path of the yarn-carrying bar 14. In this case, the negative compensation participates in part to the compensation of the movement of the breast-beam. This is a non-optimal condition which however can be managed through an accurate adjustment of the elastic means 16.

[0035] It cannot however in any case occur, in view of the geometry of the levers, the case of a run of the breast-beam lower than the positive path of the yarn-carrying bar 14. Such a configuration would imply a too high positive compensation, which would cause an excessive loosening of the tension of the pile warp yarns.

[0036] The benefits of the positive compensation device described above, compared to the negative compensation system normally used for this application, are essentially the following:

- the preload of the elastic means 16 must compensate the only change in the tension of the warp yarns caused by the shed opening and by the reed beating-up for forming the pile and thus not the one caused by the movement of the breast-beam. This allows to have quite an easy adjustment of the system;
- independence from the inertia of the system, because the weight of the structure, boosted by the increase in the operating speed of the loom, does not affect the effectiveness of the compensation.
- active adjustment of the run of the of the pile warp tensioner with an increase in quality and size of the pile.

[0037] It is understood, however, that the invention is not to be considered as limited by the particular arrangements illustrated above, which represent only exemplary implementations of the same, but different variants are possible, all within the reach of a person skilled in the art, without departing from the scope of the invention itself, which is exclusively defined by the following claims.

Claims

1. Device for adjusting the tension of the pile warp yarns, in a mobile breast-beam terrycloth weaving loom, of the type comprising a pile warp roll assembly (G) with a warp tensioner roll (13) provided with a negative compensation movement of the shed opening and of the reed beating-up for forming the pile, **characterised in that** said warp tensioner roll (13) is furthermore provided with a positive compensation movement of the alternate displacement of the pile warp yarns.

2. Device for adjusting the tension of the pile warp yarns as in claim 1, wherein said positive compensation movement and negative compensation movement of the warp tensioner roll (13) are mutually separated.

3. Device for adjusting the tension of the pile warp yarns as in claim 2, wherein said positive compensation movement of the warp tensioner roll (13) is operated, through a separate mechanism, by the same control which drives the alternate movement of the breast-beam (F).

4. Device for adjusting the tension of the pile warp yarns as in claim 3, wherein said mechanism causes the rotation of said warp tensioner roll (13) around its own axis and said positive compensation movement is provided by a yarn-carrying bar (14) integral with

said warp tensioner roll (13).

5. Device for adjusting the tension of the pile warp yarns as in claims 3 or 4, wherein said mechanism comprises a slot/slide coupling which is inactive or only partly active during the negative compensation of the warp tensioner roll (13) and which is active during the positive compensation of the warp tensioner roll (13).

6. Device for adjusting the tension of the pile warp yarns as in claim 5, wherein the longitudinal axis of said slot is substantially parallel to the negative compensation movement of the warp tensioner roll (13).

7. Device for adjusting the tension of the pile warp yarns as in claim 5, wherein the longitudinal axis of said slot is suitably inclined with respect to the negative compensation movement of the warp tensioner roll (13), so that, during said negative compensation movement of the warp tensioner roll (13), the yarn-carrying bar (14) rotates around the warp tensioner roll (13) to provide a partial positive compensation even during the steps of shed opening and of reed beating-up for forming the pile.

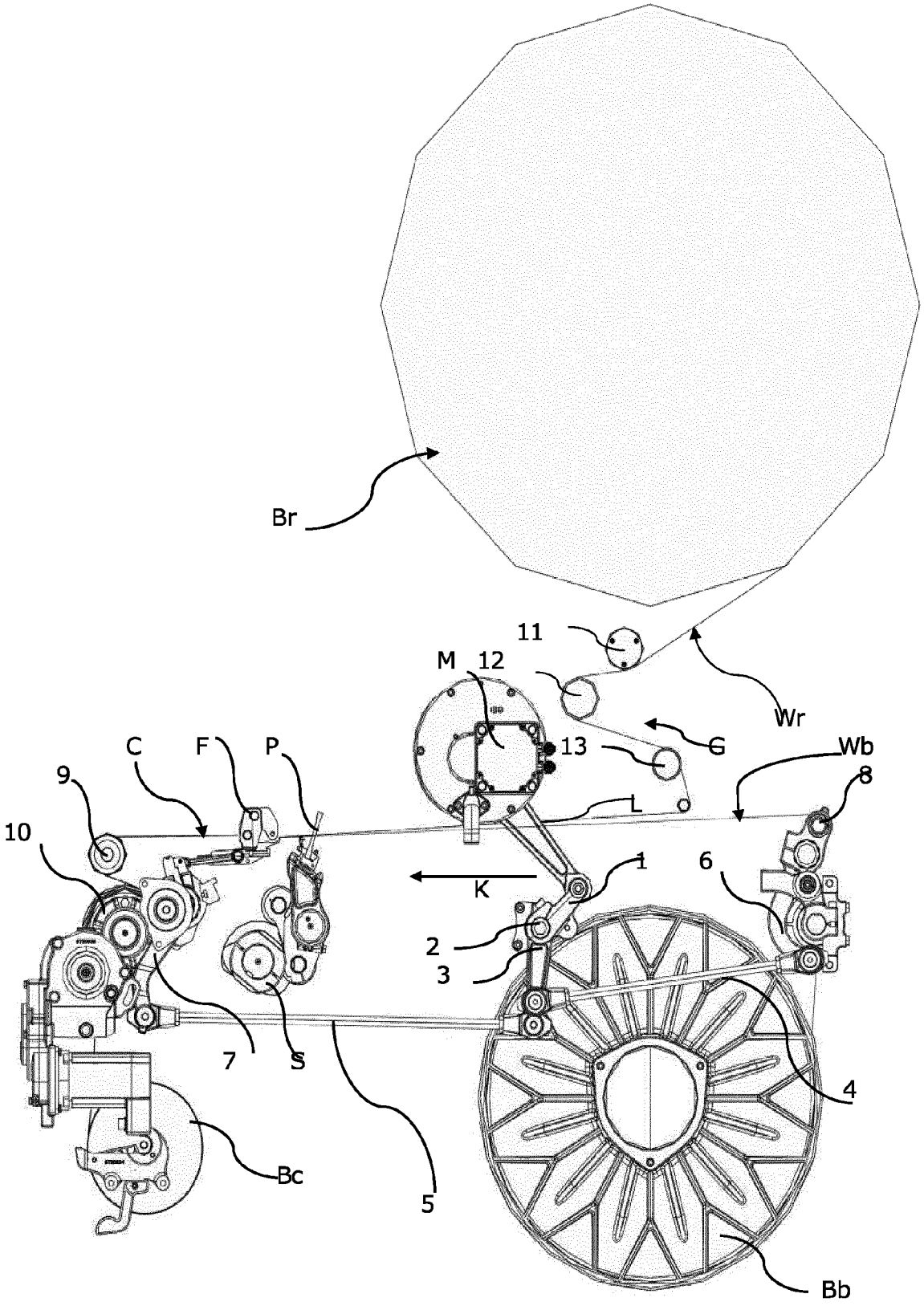

FIG. 1

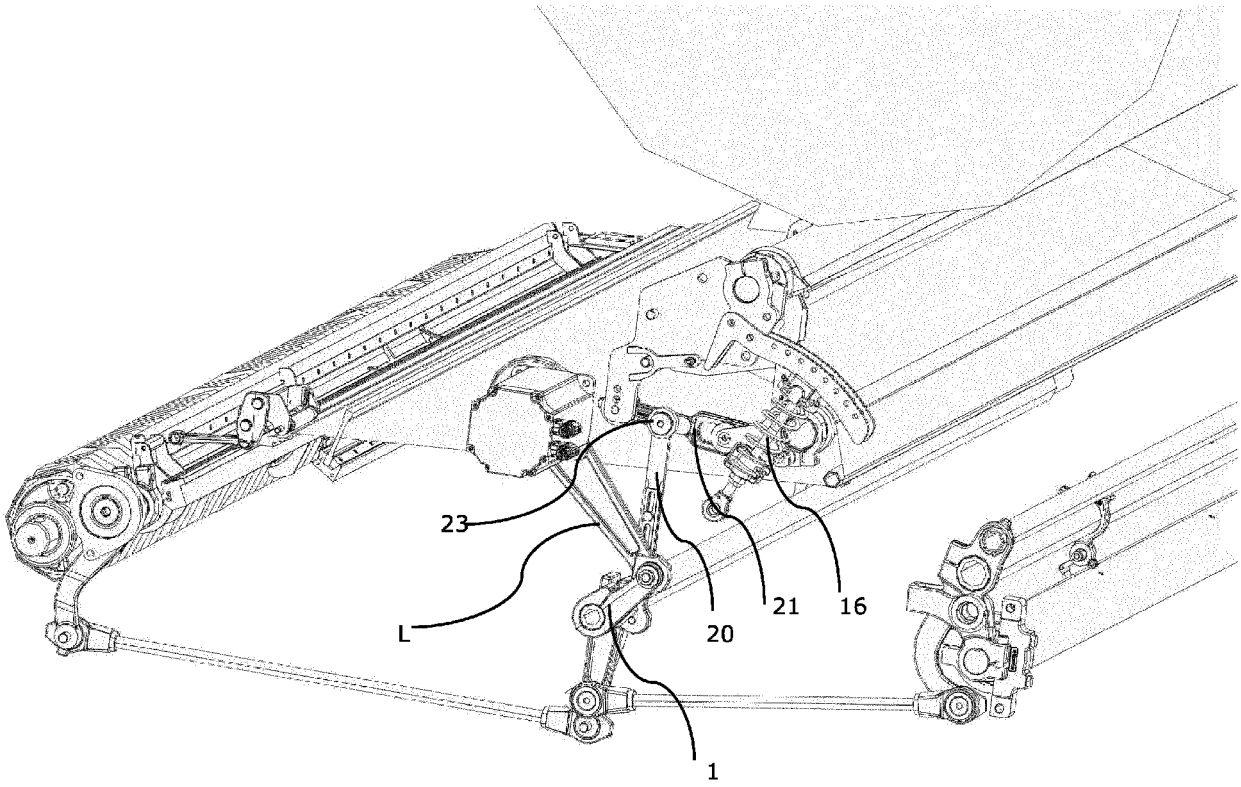

FIG. 2

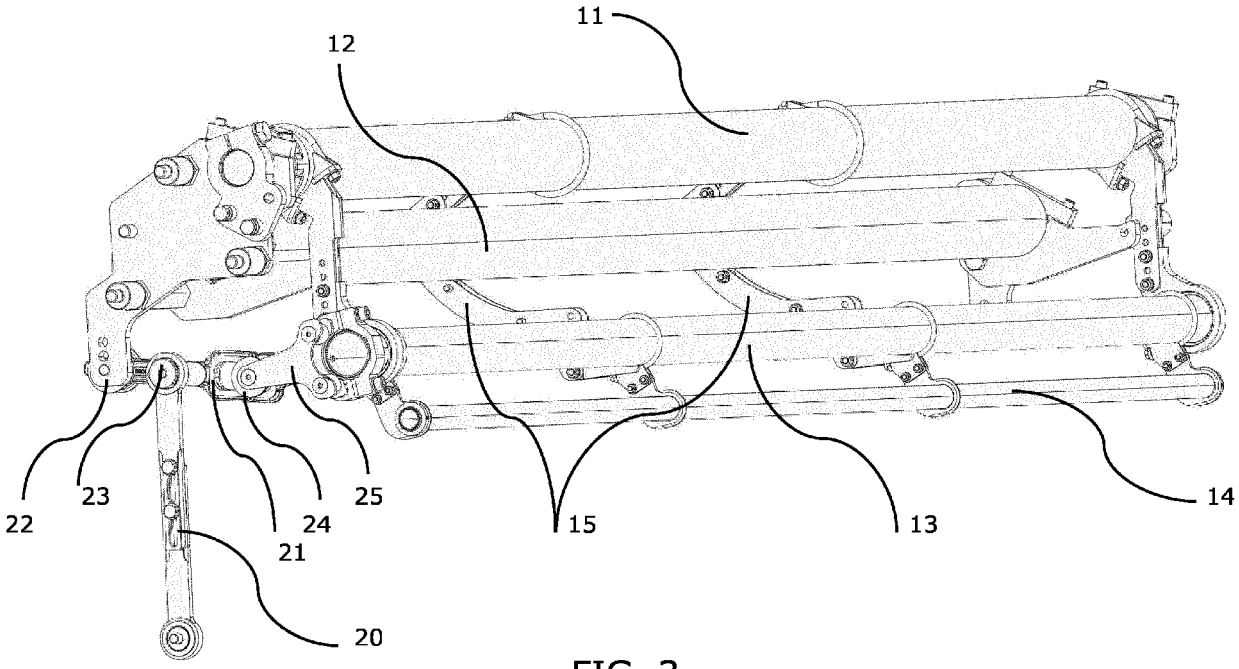

FIG. 3

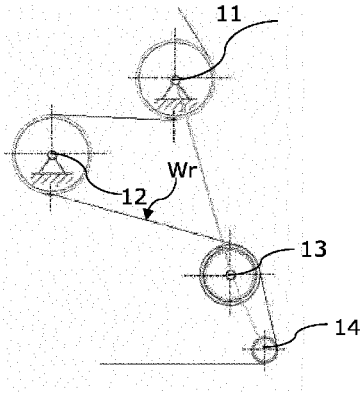

FIG. 4A

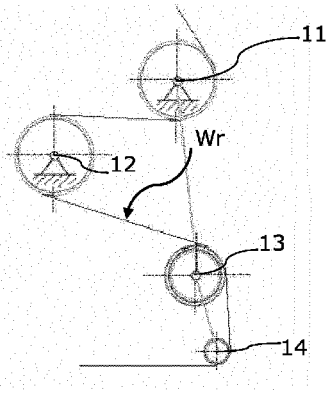

FIG. 4B

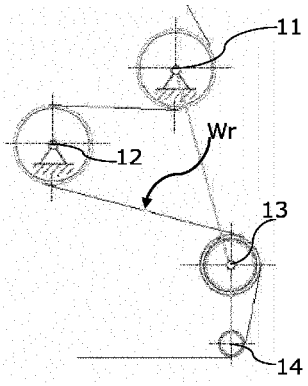

FIG. 4C

REFERENCES CITED IN THE DESCRIPTION

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